Stormwater Rule Economic Analysis

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by

Todd Doley from USEPA Office of Water

Objectives for the Economic Analysis

- Develop an estimate of national costs going out 25 year from anticipated rule promulgation;
- Identify what appear to be the major cost drivers, sources of cost savings, and what areas of the country will the costs be concentrated;
- Assess the economic impacts to various sectors (industry, government, households); and
- Estimate the economic benefits associated with improvements in water quality and increased green space attributable to the rule.

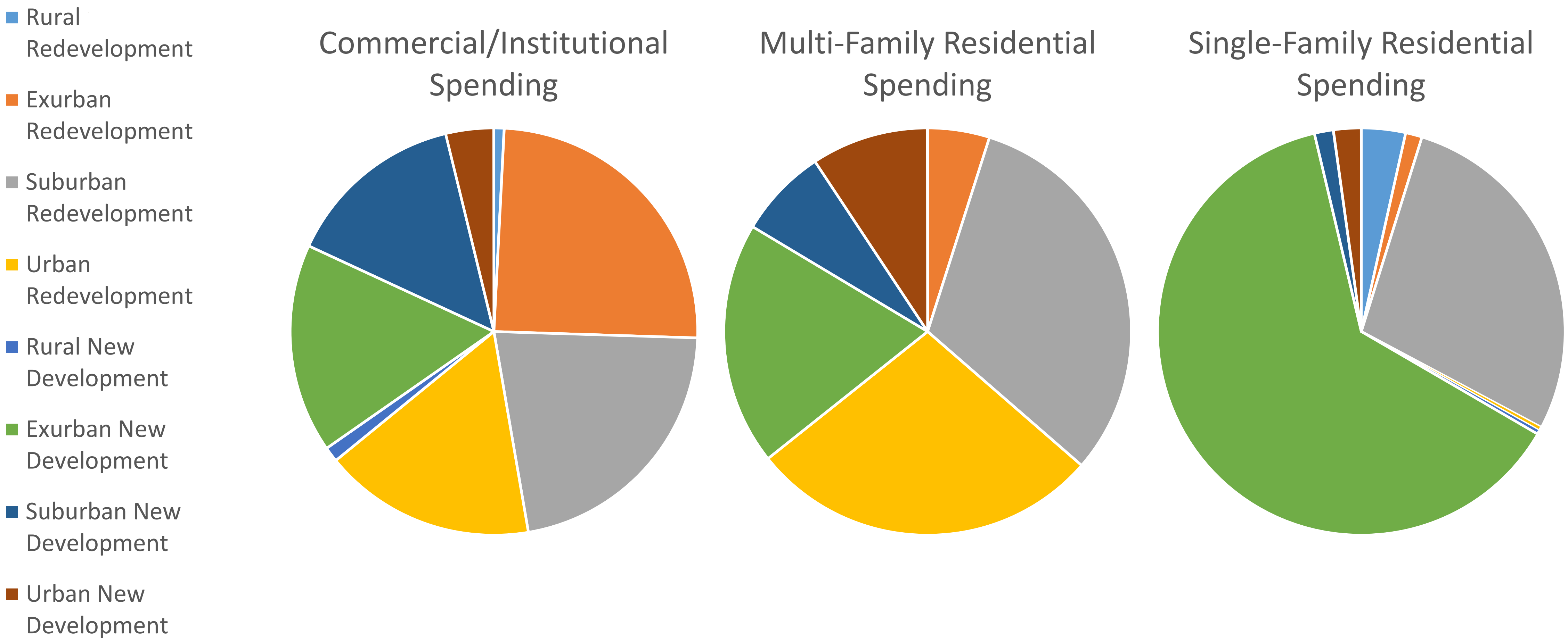
From Engineering Analysis Results to National Costs

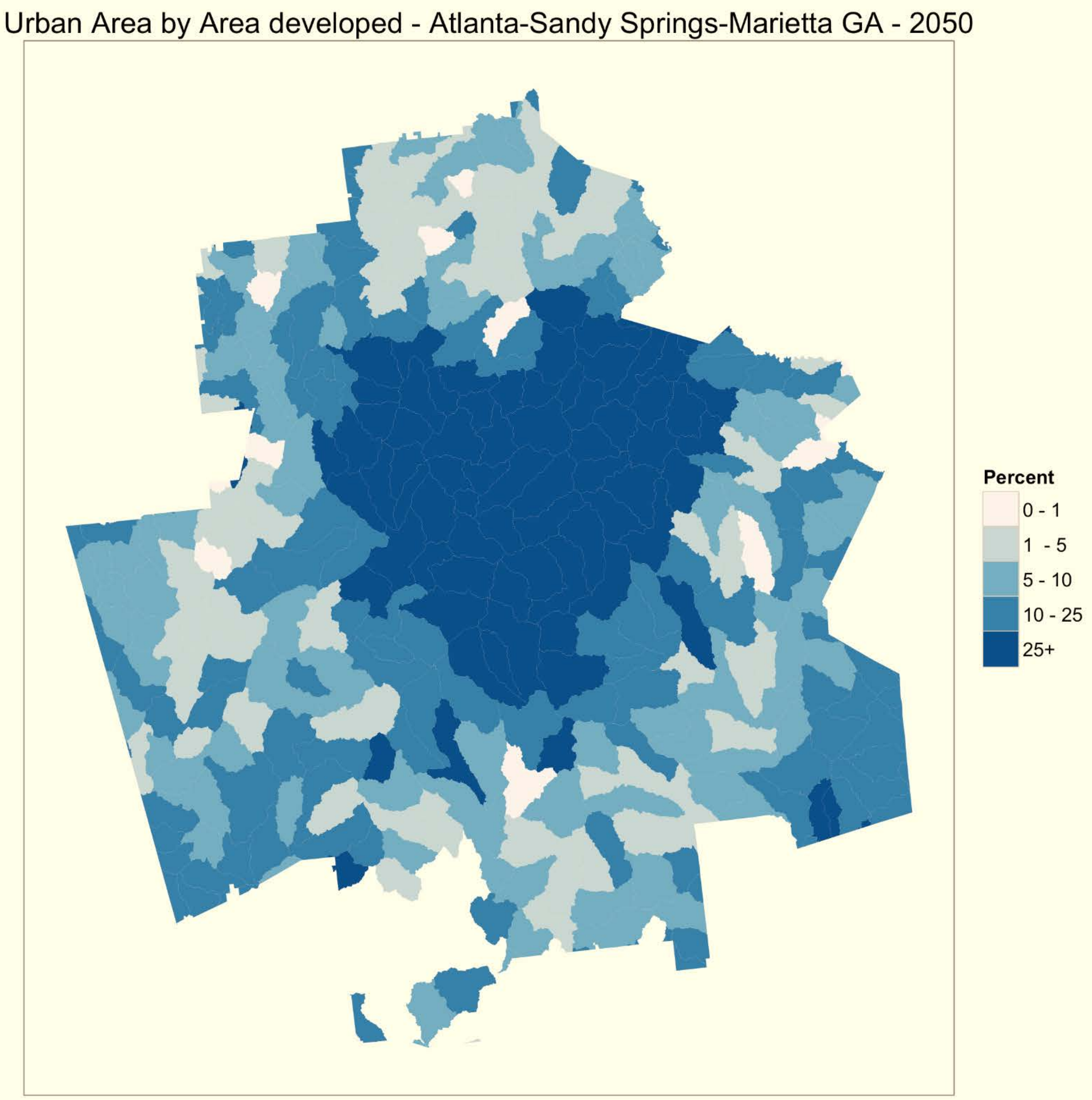
- The engineering analysis produced results for the set of model projects using numerous combinations of possible site, regulatory, and market conditions (approximately 20 million combinations)
- To derive national cost estimates, need to predict how frequently each of the various combinations occurred
- EPA developed the Project Prediction Model (PPM) to forecast future development projects, which could be combined with the engineering results to estimate how the rule would be implemented nationally and what the resulting costs would be

Project Prediction Model:
Forecasts future development projects

- Combines forecasts of future construction spending, population growth, and migration patterns with historical data on project characteristics (ie. size, value, impervious cover, new or redevelopment status)
- Generates a set of future projects potentially subject to the rule for the years 2016 – 2040, and at HUC12 watershed scale.
- Projects are classified as single-family residential, multi-family residential, commercial/institutional, or industrial
- Additional project characteristics are:
  - Nearest of climate station (300 possible)
  - Soil type
  - Development density type (urban, suburban, exurban, rural)
  - Regulatory status

National Summaries of Predicted Construction Spending




Urban Area by Area developed - Atlanta-Sandy Springs-Marietta GA - 2050
Percent
0 - 1
1 - 5
5 - 10
10 - 25
25+

Summary Predicted Projects for years 2020 - 2040

	Projects		Development Acres		Impervious Acres	
	#	%	#	%	#	%
New Development Inside Reg MS4s	536,030	36%	9,443,322	35%	2,747,609	29%
Redevelopment Inside Reg MS4s	497,003	33%	8,992,294	33%	3,825,437	40%
New Development Outside Reg MS4s	282,595	19%	4,864,890	18%	1,454,198	15%
Redevelopment Outside Reg MS4s	176,729	12%	3,600,671	13%	1,453,597	15%
Total Development	1,492,357		26,901,177		9,480,842	

Transportation Projects

- Federal Highway Administration data: Total Lane-Mileage by Year, County, and Functional System (2000-2009 part)
- Census data: County population, population change and estimated components of population change: April 1, 2000 to July 1, 2009.
- County-level Census population data was joined to the total mileage data by county, and year. EPA then grouped the mileage data by functional system tier.

Tier	Roadways included in Functional System Tier
1	Rural Interstate, Rural Other Principal Arterial, Urban Interstate, Urban Other Freeways & Expressways, and Urban Other Principal Arterial
2	Rural Major Collector, Rural Minor Collector, Urban Collector, Rural Minor Arterial, and Urban Minor Arterial
3	Rural Local and Urban Local

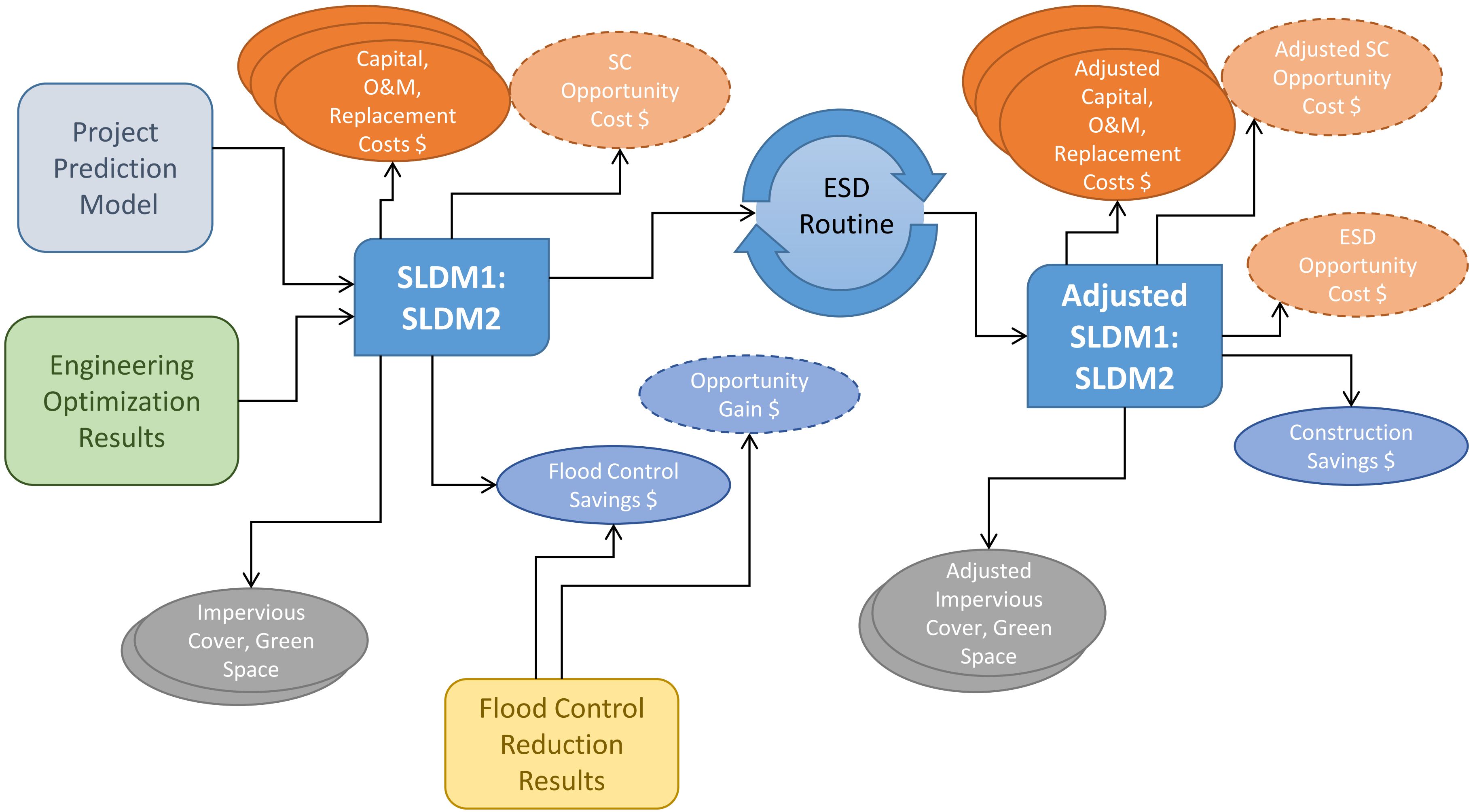
- A regression model was developed for each tier to predict increases in those roadway miles as a function of estimated future county population changes.

Project Cost Model

Combines project forecast with engineering results to predict national costs

- For each project:
  - selects two modeled projects from engineering analysis with the closest site conditions, weights the engineering results based on % impervious surface;
  - estimates compliance costs using different assumptions regarding potential opportunity costs;
  - estimate the future occurrence of local codes and ordinances that can affect compliance decisions;
  - estimates potential site design changes to reduce impervious surface and lower compliance costs;

Cost Model


Project Prediction Model
Engineering Optimization Results
Capital, O&M, Replacement Costs $
SC Opportunity Cost $
SLDM1: SLDM2
ESD Routine
Adjusted Capital, O&M, Replacement Costs $
Adjusted SC Opportunity Cost $
ESD Opportunity Cost $
Adjusted SLDM1: SLDM2
Opportunity Gain $
Flood Control Savings $
Construction Savings $
Impervious Cover, Green Space
Adjusted Impervious Cover, Green Space
Flood Control Reduction Results

Potential Changes to Site Design

- Environmental Site Design
  - Impervious surface now costs more relative to greens space
  - Reducing parking lot areas and narrowing street widths lessens the runoff volume that needs to be controlled
  - EPA is actively encouraging states and metro areas to conduct reviews of codes and ordinances that may limit the use of environmental site design and green infrastructure
- Reduced need for Flood Storage
  - Most projects will have to meet local flood storage requirements
  - Typically through detention ponds (wet/dry) or detention vaults
  - Retention practices required by the rule offset the volume that needs to be captured for flood storage

Cost Model Limitations & Uncertainties

- What is the appropriate baseline
- How to determine if the policy is more protective (stringency determination)
- ESD implementation
- Codes and Ordinances
- Climate Change

Economic Impacts Analyses

- We looked at combinations of retention standards ranging from 80^{th} to 90^{th} percentile to estimate the range of possible economic impacts, all assuming ≥ 1 acre threshold

- Housing Affordability

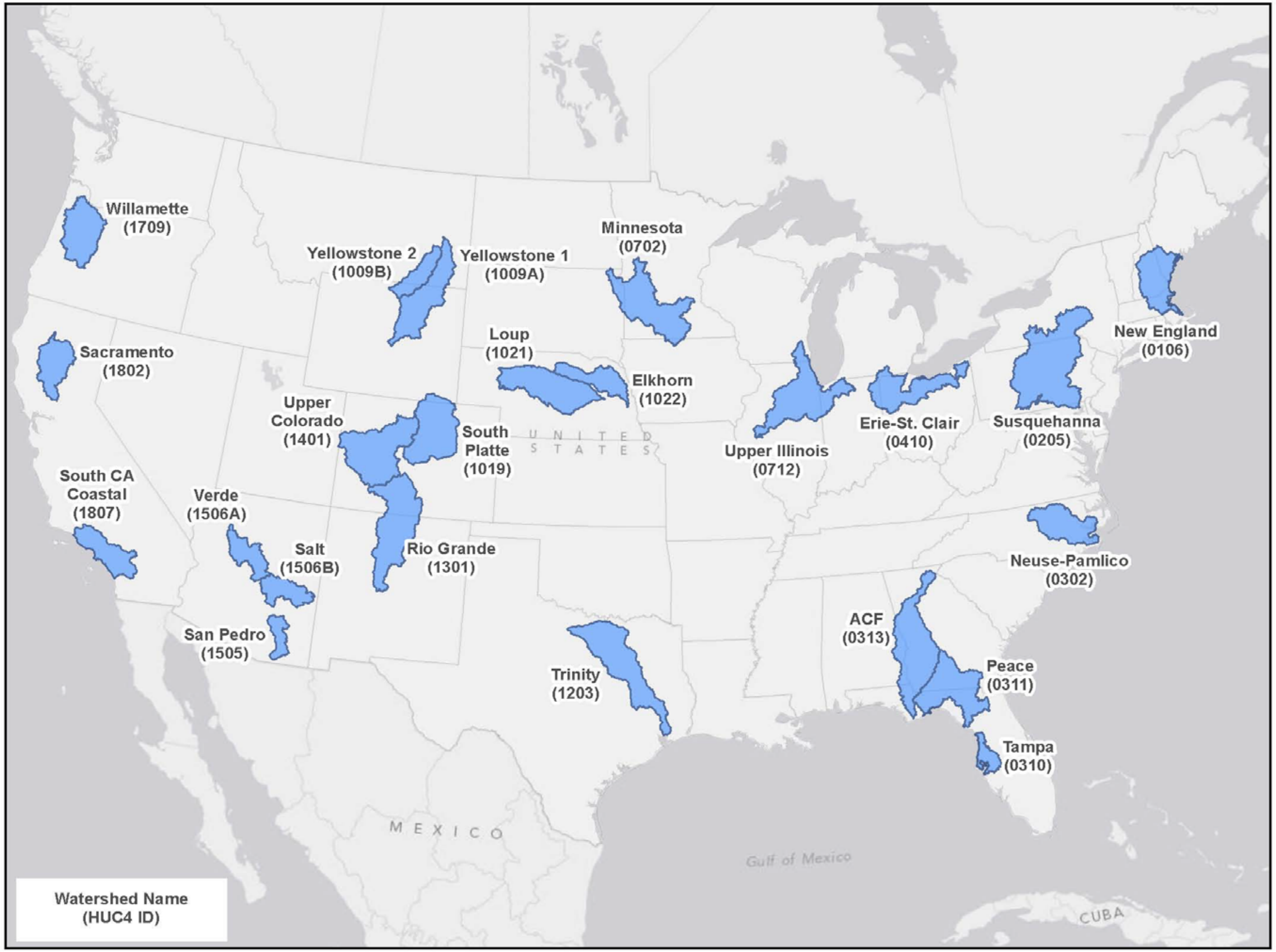
- State/Local Government Impacts

- Firm (Industry) Impacts

Benefits Analysis

- Water quality benefits estimated using the project-level stormwater controls and IC changes from engineering and cost analyses as inputs for the SWAT watershed model.
  - Modeled at the HUC 10 subwatershed scale for 20 HUC 4 watersheds;
  - Accounted for the pattern of precipitation over time with consecutive storm events rather than using long-term average conditions;
  - Simulated BMP effects on watershed processes, such as subsurface water storage and flows;
  - Accounted for existing stormwater management requirements

The 20 HUC 4 Watersheds used for the SWAT Modeling



Water-Based Monetized Benefits

Improved recreational, aesthetic and non-use values

Changes in downstream pollutant concentrations are used to estimate changes in use and non-use values, which are then monetized using a meta-analysis of WTP studies.

Lower drinking water treatment costs

Monetized the changes in treatment costs associated with reduced turbidity in surface water supplies.

Lower dredging costs for navigational channels

Estimated the incremental difference in the need for dredging navigable waterways. Then used unit costs for dredging to estimate the cost savings from dredging less frequently.

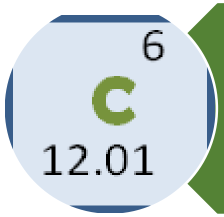
Reduced siltation of water storage reservoirs

Estimated the incremental difference in sediment accumulation in reservoirs and used unit costs for dredging to estimate the cost savings of the reduced need for dredging.

Vegetation-based Monetized Benefits

Improved air quality and reduced human health impacts

Estimated incremental changes in vegetation. Estimate net reductions in atmospheric pollutant concentrations. Estimate human health benefits from reduced exposure.



Carbon uptake by plants

Estimated incremental changes in vegetation. Calculated net changes in carbon sequestration. Used the social cost of carbon (SCC).

Reduced energy use by buildings and associated air quality and greenhouse gas benefits

Estimated incremental increase in tree shade and the effect on energy consumption. Estimated cost savings to energy consumers using retail energy prices.

Higher off-site property values associated with green infrastructure

Estimated incremental increase in green space for residential development projects. Estimated the resulting improvements in property value for nearby existing residential properties.

Non-Monetized Benefits, Costs, and Cost Savings

Benefits

- Monetized benefits probably underestimate total benefits.
- Important non-monetized benefits include:
  - Most impacts to small streams – the most heavily affected waters due to pollution, flow modification, erosion, and habitat loss.
  - Water quality benefits to estuarine, coastal, and marine waters
  - Pollutant effects from organic matter, metals, pathogens, salts, trash and debris, temperature modification, pesticides, and other toxic organics
  - Human health effects from water contact and fish and shellfish consumption
  - Property/infrastructure damage from erosion and sedimentation
  - Water treatment (other than sediment at drinking water facilities)
  - Municipal storm sewer operation and maintenance costs
  - Commercial fisheries

Costs and Cost Savings

Important non-monetized costs include:

- Transition/learning curve costs
- Savings from use of gray infrastructure/culverts being offset by use of green infrastructure
- Savings associated with the use of off-site mitigation to implement the performance design standard

Contact Information

Economic Analysis
Todd M. Doley
USEPA
doley.todd@epa.gov
202-566-1160

Benefits Assessment
Ashley Allen
USEPA
allen.ashley@epa.gov
202-566- 1012

Climate Resiliency Analyses
Lisa Hair
USEPA
hair.lisa@epa.gov
202-566- 1043

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